

LOWER LIASSIC FACIES ZONES IN THE BAKONY UNIT OF HUNGARY

by

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Abstract

Contrasting lithology, highly varied sediment thickness and differences in the timing of pelagic sedimentation provide a threefold division of the Bakony unit in Hettangian and Sinemurian. A deep basin in the Zala region with variable topography, containing black marls, corresponds to the Lombardian basin of the Southern Alps. A carbonate platform in the Bakony Mts. corresponds to the Trento plateau and a contemporaneous pelagic basin (Gerecse Mts.) with highly condensed sedimentation to the Belluno trough.

Introduction

The Bakony unit is situated in the NW part of the Pannonian basin. It is bordered by two strike-slip faults, which are parts of the Periadriatic lineament system, to the NW and to the SE (KÁZMÉR, 1986) (Fig. 1). It has been displaced from the Alps to its actual position by an Oligocene continental escape (KÁZMÉR and KOVÁCS, 1985). Its Jurassic formations, among others, are closely similar to those of the Southern and Eastern Alps (GALÁ CZ and VÖRÖS, 1972, and references therein). The marked differentiation of the Southern Alps into distinct facies zones: e.g. the Friuli platform, the Belluno trough, the Trento plateau, and the Lombardian basin with several internal swells and troughs (WINTERER and BOSELLINI, 1981, with further references) made us to look for similar features in the Bakony unit. This paper summarizes the results for the Lower Liassic (Hettangian-Sinemurian, occasionally Pliensbachian) stages.

Ten published Hettangian-Sinemurian surface profiles with good biostratigraphical control ranging from the western end of the Bakony Mts. through Vértes Mts. to Gerecse Mts. (Fig. 2) are correlated with each other (Fig. 4) emphasizing lithology and sediment thickness. Six, partly unpublished subsurface profiles from the Zala region at the westernmost end of Bakony unit in Hungary, representing the whole Liassic due to less accurate or no biostratigraphic control are added. Lithology, sediment thickness and fossil content are interpreted in the framework of a basin and plateau topography very briefly, due to space limitations. A more detailed treatment will be published later.

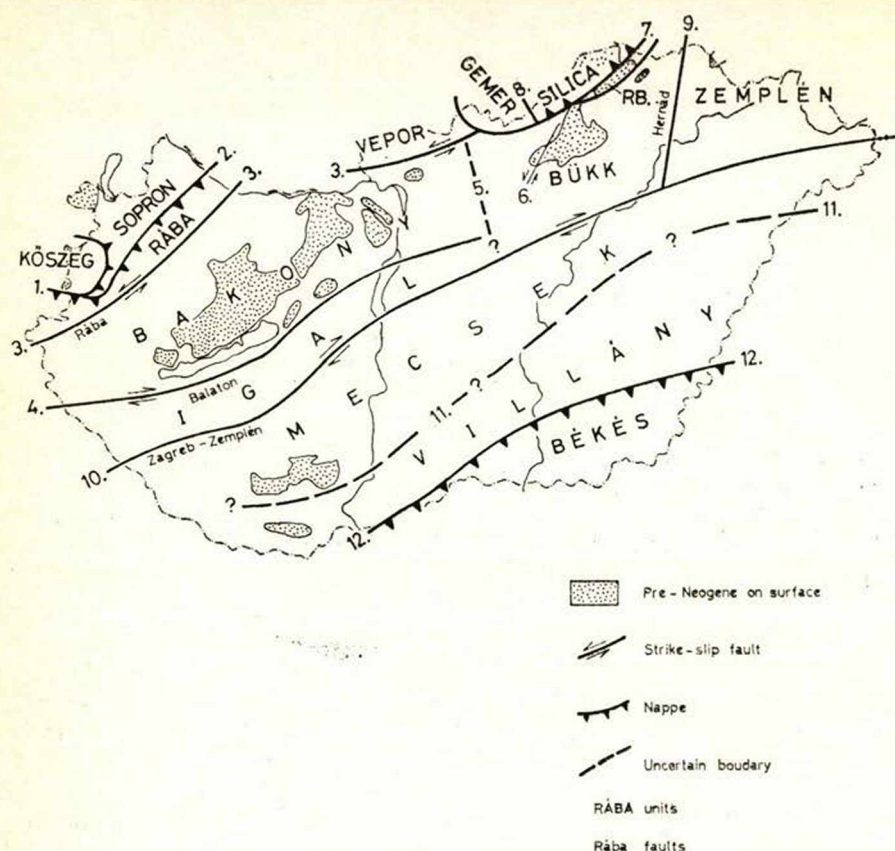


Fig. 1. Tectonic units of Hungary (Kázmér, 1986). Stippled: pre-Neogene formations of the surface. RB = Rudabánya unit.

Stratigraphy (Fig. 3)

Standard stratigraphic review papers of Bakony unit also provide evidences for the depositional environments (FÜLÖP, 1971), for a Mediterranean-type dissected submarine topography (GALÁ CZ and VÖRÖS, 1972), for basin evolution (GALÁ CZ, 1984). GALÁ CZ et al. (1985) interpreted the Jurassic Bakony unit as part of the southern, distensional passive margin of the Tethys.

A brief description of Lower Liassic formations is given here; for further references see KÁZMÉR (1986).

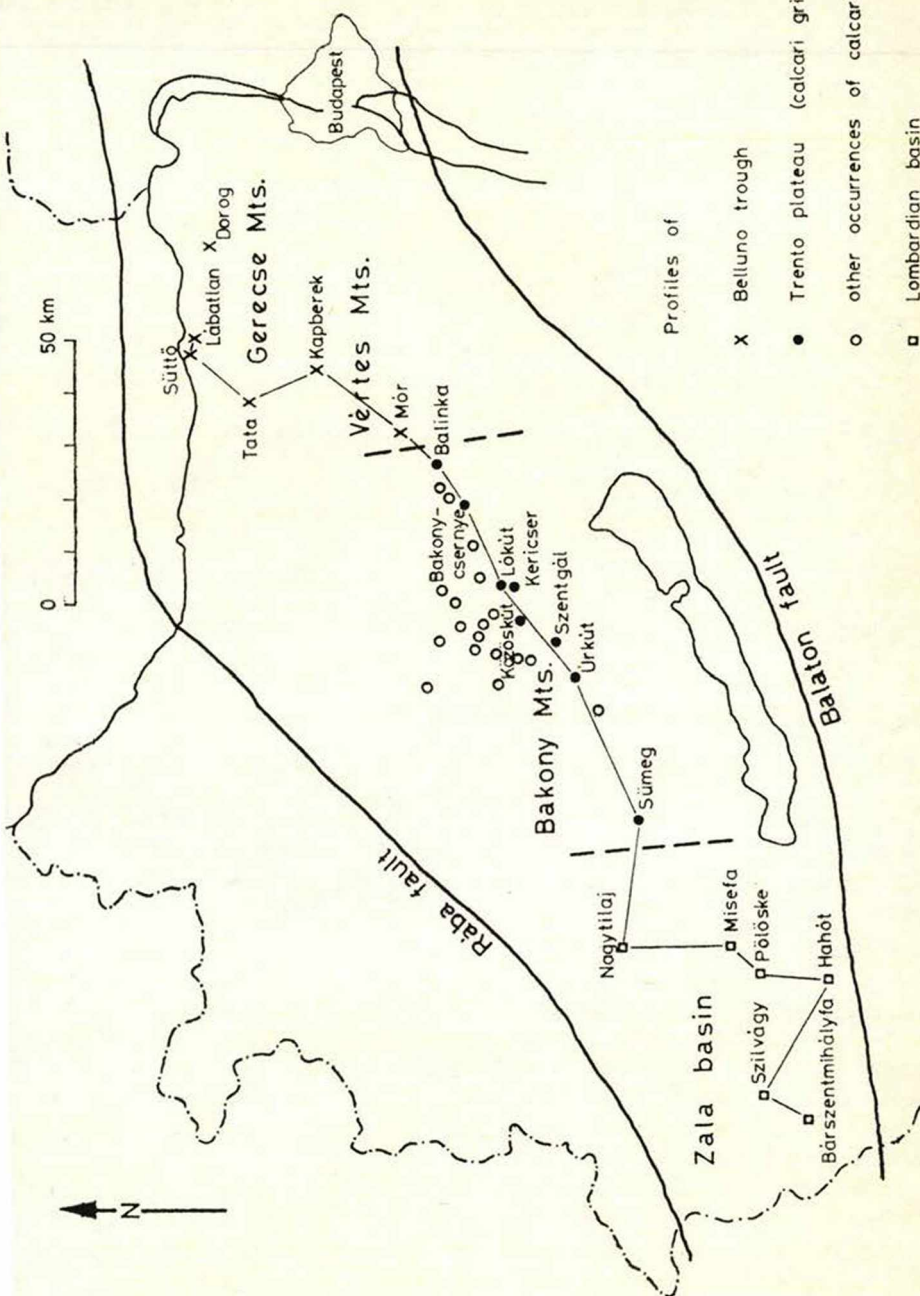


Fig. 2. Location of Lower-Middle Liassic profiles in the Bakony unit. The long profile is shown on Fig. 4. The dashed line indicates the approximate position of the boundaries between the two basins to the W and E and the plateau in the middle.

Dachstein Limestone (Norian-Rhaetian)

Well-developed Lofer cyclothems (HAAS, 1982; HAAS and DOBOSI, 1982) and locally frequent Megalodontaceae (VÉGH-NEUBRANDT, 1982) characterize this formation, deposited in an open platform environment. The Triassic–Jurassic boundary is traditionally drawn at a minor facies change within the platform limestone. Lofer cyclothems, Megalodontaceae and the foraminifer *Triasina hantkeni* MAJZON disappear, and locally brachiopods and oncoids appear. The latter, Jurassic formation is the

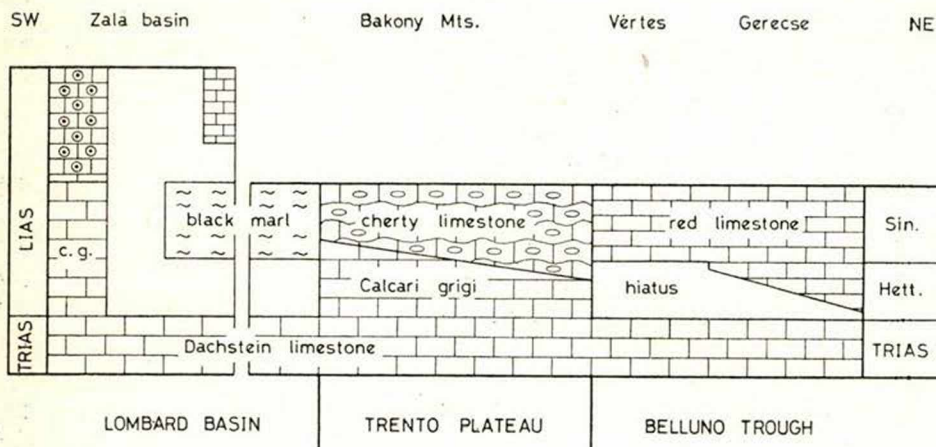


Fig. 3. Age relationships of Lower Jurassic formations in the Bakony unit. Hierlatz Limestone (crinoid-brachiopod grainstone) is not indicated within Bakony, Vértes and Gerecse Mts., being frequent, but of local importance.

Kardosrét Limestone (= Calcarei grigi) (Hettangian-Lower Sinemurian)

GALÁCZ et al. (1985) interpreted it as a limestone resedimented from neighbouring platform areas onto a drowned platform, like the Vajont Oolite in the Southern Alps (BOSELLINI et al., 1981). But the only available up-to-date description of HAAS et al. (1984) provided opposing evidences. While the Triassic Dachstein Limestone is biomicrite and pelmicrite with grainstone intercalations, the Kardosrét Limestone is mostly pelmicroparite, with rare oncoids. Its uppermost part is oncomicrosparite (HAAS et al., 1984). The predominance of the micritic matrix makes a redeposition process highly improbable.

Lower Sinemurian brachiopods (VÖRÖS in HAAS et al., 1984) have been found in the upper part of the formation. Its age, thickness (up to 150 m) and shallow marine depositional environment make the Kardosrét Limestone similar to the Calcarei grigi of the South Alpine Trento platform; that's why the latter name is applied in Fig. 3.

Cherty limestone (Hettangian-Sinemurian)

This lithological name is applied in a rather general way to the formations overlying the Lower Liassic platform limestones. It contains mostly grey or red spiculitic cherty limestones, forming most of the sequence in thickness; minor quantities of red, compact limestones and (partly Hierlatz-type) crinoid limestones belong to this group (Fig. 5). All these types pass into the Rosso Ammonitico sequence upwards (GÉCZY, 1961; KONDA, 1970). For further references see KÁZMÉR (1986).

Red limestone (Hettangian-Sinemurian)

Compact, mostly red, rarely grey limestone (Adneth Limestone). Locally Hierlatz-type crinoid limestones occur (FÜLÖP, 1976). Further references in KÁZMÉR (1986).

Crinoid limestone (Liassic) in the Zala region

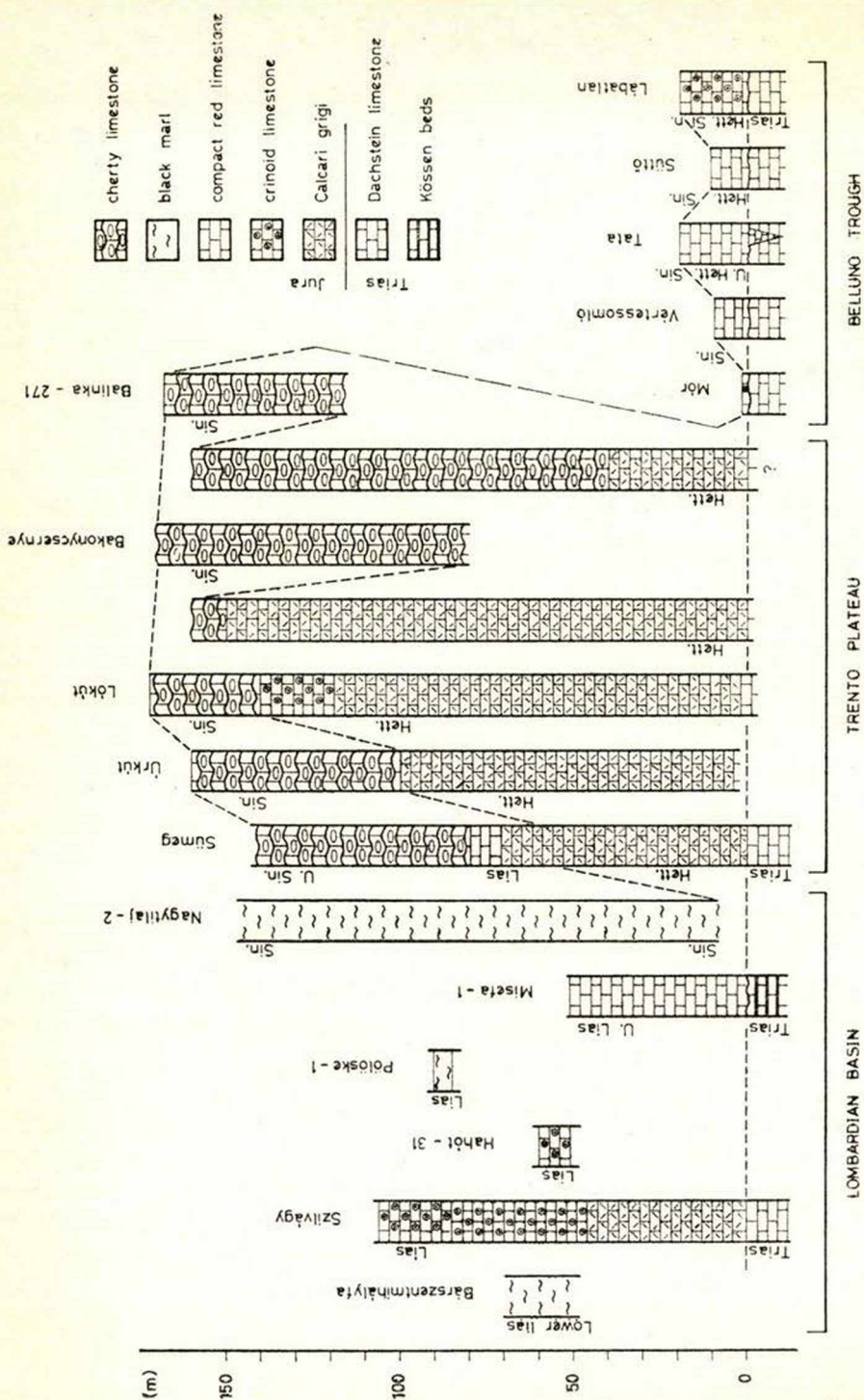
Separately indicated in the sequence of the Szilvagy oilfield. Its relatively great thickness (65 m; unfortunately, dip data are not available) deserves its separate treatment; however, it frequently occurs in other localities, surface or subsurface, in minor quantities (BÉRCZI—MAKK, 1980). In Hahót—31 borehole it is the only Liassic sediment (KÖRÖSSY L., 1986, pers. comm.).

Black marl (Sinemurian)

Grey marl, clayey limestone, black marly shale with foraminifers and ostracods. The brachiopods *Rhynchonella palmata* and *R. fraasi* (det.: J. NOSZKY) indicate Sinemurian age (VÖRÖS, 1986, pers. comm.; KÖRÖSSY, 1965; 1986, pers. comm.; MAJZON, 1966). It occurs in Nagytilaj—2 borehole only. Less known occurrences of Liassic black marl and dark nodular limestone in boreholes Bárszentmihályfa and Pölöske were kindly mentioned by KÖRÖSSY (1986, pers. comm.).

Beginning of red sedimentation

The occurrence of the first red (or grey; i.e. not white) pelagic sediments over the platform limestones is indicated in Fig. 5. Apparently it shows high diachronism, but it partly may be due to the absence of characteristic fossils. All ages were determined by ammonites, except in the Nagytilaj—2 and Lókút Hill profiles; where brachiopods gave good evidences. The sequence of borehole Balinka—271 is ranged on lithological grounds only. At the first glance we can conclude, that the red, pelagic sedimentation started about an age later in the zone named Trento plateau (except Lókút Hill profile) than in the neighbouring profiles. For references see the captions of Figs. 4. and 5.



Facies zones

The lithological variations (Fig. 4), the significant thickness variations (Fig. 4) and the differences in the beginning of red, pelagic sedimentation (Fig. 5) enable us to differentiate three facies zones in the Bakony unit of Hungary. The analogue is the Southern Alps, therefore names of that region are applied here.

"Lombardian basin"

It covers the present-day geographic region of the Zala basin (Fig. 2). While the other two zones are defined after their Lower Liassic sequences, here the whole Liassic is considered, since biostratigraphic control rarely permits more precise dating of rocks.

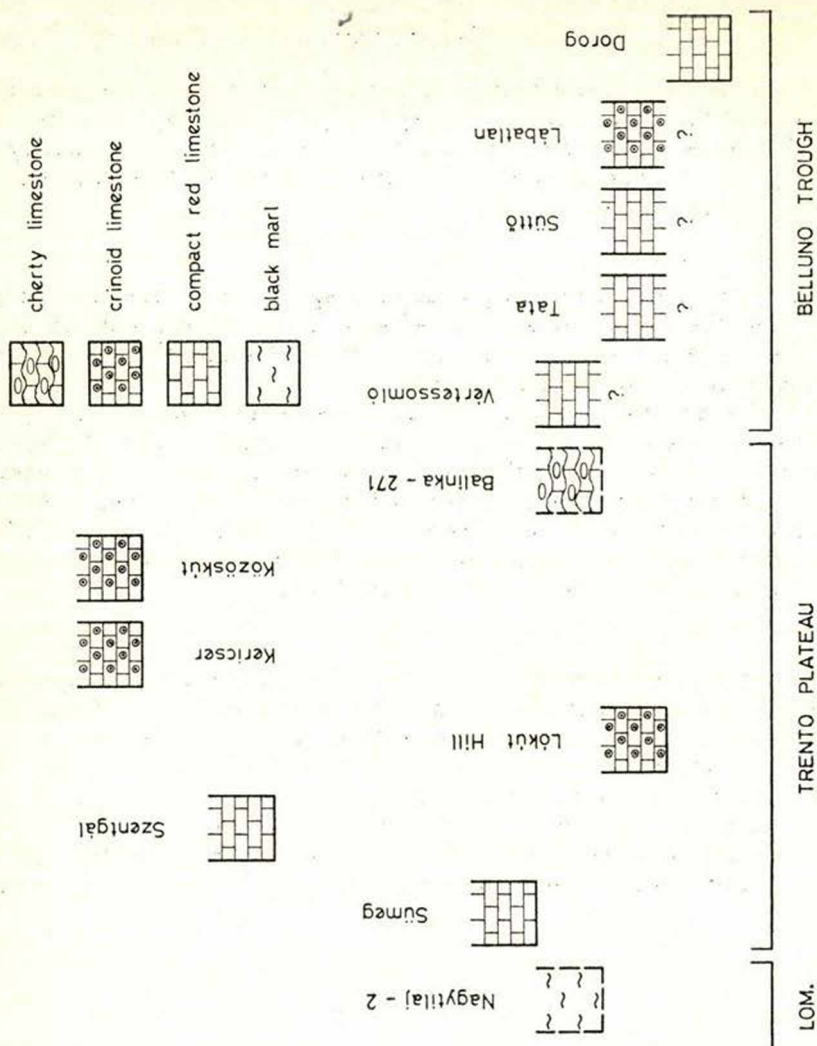
The Lombardian basin in Hungary displays a dissected topography with varied rock types. The Sinemurian black marl (134 m at Nagytilaj, unknown thicknesses at Pölöske and Bárszentmihályfa) indicates the greatest depths of the basin, concentrating the clastic sediments. All other localities in all three zones contain carbonate rocks only. The Szilvagy profile might be a local swell in the Lombardian basin, displaying a sequence highly similar to the Trento zone of the Bakony Mts.

"Trento plateau"

It covers the present-day Bakony Mts. The Hettangian (and partly Lower Sinemurian) sequence of this zone is formed by Calcari grigi-like platform carbonates (Kardosrét Limestone). Its thickness reaches 150 m. The red, pelagic sedimentation, e.g. the break-up of the platform started in the Sinemurian (with the exception of Lókút Hill profile, where it started in the Late Hettangian. It might have been a minor trough of local importance.) The occurrence of the Calcari grigi, i.e. the existence of Hettangian platform sedimentation is the unique feature of this zone.

Fig. 4. Stratigraphic columns of Lower Liassic profiles in the Bakony unit. Biostratigraphic control of sedimentation in the "Lombardian basin" is insufficient; therefore all profiles described as "Liassic" were included. The "Belluno trough" is characterized by condensed pelagic sedimentation; thick, neritic Calcari grigi is characteristic for the "Trento plateau"; and variable sequences with conspicuous, thick, pelagic black marls occur in the "Lombardian basin". Sources: Bárszentmihályfa: KÖRÖSSY (1986, pers. comm.); Szilvagy: BÉRCZI-MÁRK (1980), KÖRÖSSY (1986, pers. comm.); Hahót - 31 and Pölöske - 1: KÖRÖSSY (1986, pers. comm.); Misefa - 1: KÖRÖSSY (1965; 1986, pers. comm.); Nagytilaj - 2: KRÖSSY (1965; 1986, pers. comm.), MAJZON (1966), VÖRÖS (1986, pers. comm.); Sümeg: HAAS et al. (1984); Urkút: FÜLÖP (1971); Lókút: FÜLÖP (1971), GÉCZY (1972a, 1972b), KONDA (1970); Bakony-csernye, Tűzköves ravine: TELEGGDI-ROTH (1934), GÉCZY (1961), FÜLÖP (1971); Balinka - 271: BERNHARDT (1986, pers. comm.); Mór, Csókahegy: FÜLÖP (1971); Vértessomló, Kapberek - 43/K - I: FÜLÖP et al. (1965); Tata, Kálvária Hill: FÜLÖP (1976); Süttő, Asszony-hegy: FÜLÖP (1971); Lábatlan, Tölgyhát quarry: FÜLÖP (1971).

JURASSIC		
Hettangian	planorbis	
	liasicus	
Sinemurian	angulata	
	bucklandi	
	semicostatum	
	turneri	
	obtusum	
Pliensb.	oxynotum	
	raricostatum	
	jamesoni	
	ibex	
	davoei	



"Belluno trough"

It covers possibly the Vértes Mts. (the extremely reduced sequences at Mór and Vértessomló) and certainly the Gerecse Mts. Instead of platform limestones in the Hettangian we find hiatus, overlain by red, pelagic limestones. Also, the Hettangian–Sinemurian sequence is extremely reduced (its thickness is 2 to 20 m instead of up to 220 m in the Trento plateau). It is probable due to strong current activity.

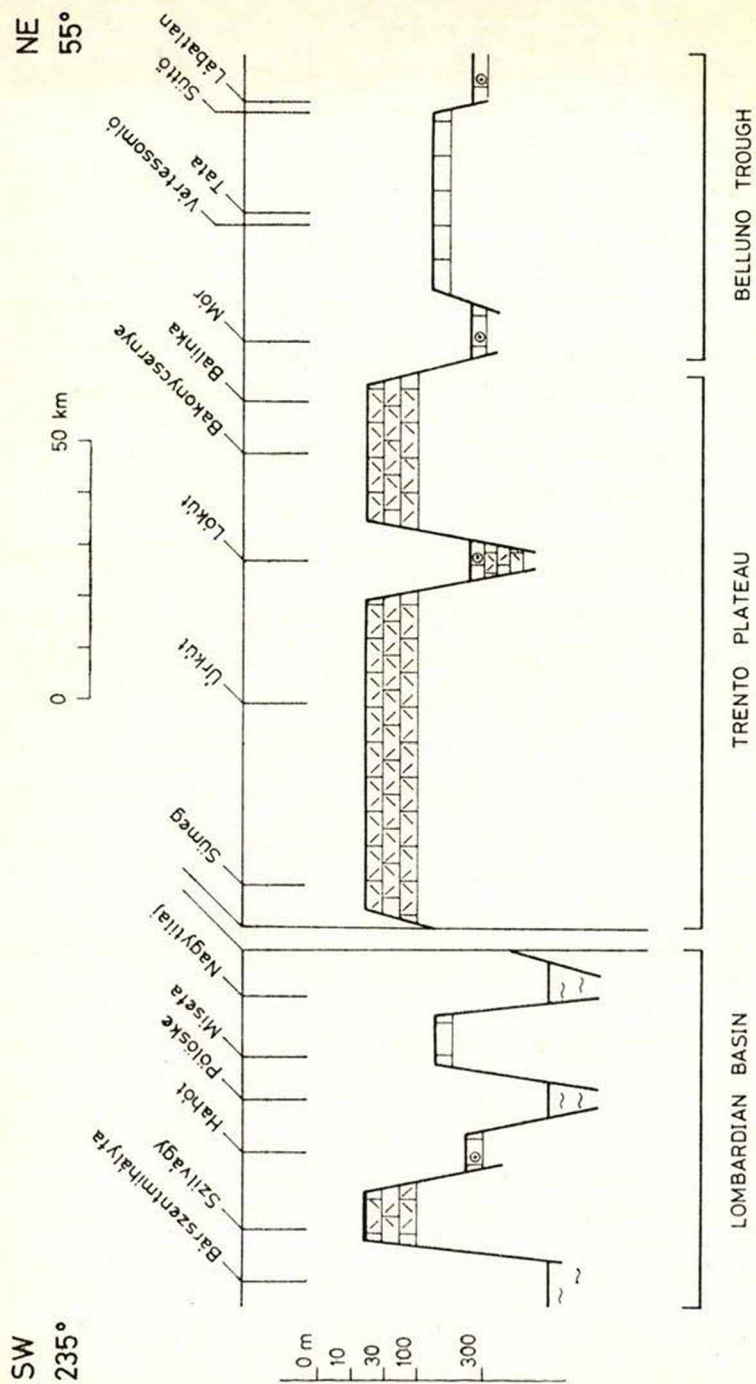
A possible palaeogeographic section emphasizing topographic differences during Hettangian time is shown in Fig. 6. The boundaries between the zones are considered to be faults, since no transition between them has been observed.

This basin and swell structure of the Lower Liassic Bakony unit provides further evidences for the palaeogeographic reconstructions of KÁZMÉR and KOVÁCS (1985) placing the Bakony unit in the immediate northern neighbourhood of the Southern Alps.

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Fig. 5. First occurrences of red, pelagic sediments (timing of the fragmentation of the carbonate platform) in the Lower Liassic of Bakony unit, as shown by biostratigraphic data. Dashed contours indicate that not the zone, but the stage is known only. Underlying sediments of the Nagytölaj black marl (Lombardian basin) are unknown; in the Trento plateau all profiles are underlain by thick *Calcarei grigi*; in the Belluno trough no *Calcarei grigi* occurs, but all sediments have been deposited on a hardground formed on Triassic Dachstein limestone. Ammonite zones after URLICH (1977). Sources: Nagytölaj – 2: KÖRÖSSY (1986, pers. comm.), VÖRÖS (1986, pers. comm.); Sümeg, Mogyorósdomb: HAAS et al. (1984); Szentgál, Tűzköveshegy: VADÁSZ (1911), GÉCZY (1974); Lókút, Lókút Hill: GÉCZY (1972a, 1972b); Lókút, Kericser: GÉCZY (1971a); Hárskút, Közöskút ravine: GÉCZY (1971b); Balinka – 271: BERNHARDT (1986, pers. comm.); Vértessomló, Kapberek: FÜLÖP et al. (1965); Tata, Kálvária Hill: SZABÓ (1961), FÜLÖP (1976); Süttő, Asszonhegy: FÜLÖP (1971); Lábatlan, Tölgyhát quarry: FÜLÖP (1971); Dorog, Nagykőszikla: VIGH (1913; correlation of ammonite zones: GÉCZY, 1976, after DEAN et al., 1961).



REFERENCES

- BÉRCZI-MÁK, A. (1980): Triassic to Jurassic microbiofacies of Szilvágy, southwestern Hungary. — *Földtani Közlemény* 110/1, 90–103, Budapest
- BOSELLINI, A., MASETTI, D., SARTI, M. (1981): A Jurassic "Tongue of the Ocean" infilled with oolitic sands: The Belluno trough, Venetian Alps, Italy. — *Marine Geology* 44, 59–95, Amsterdam
- DEAN, W. T., DONOVAN, D. T., HOWARTH, M. K. (1961): The Liassic ammonite zones and subzones of the North-West European province. — *Bull. British Mus. Nat. Hist., Geol.* 4, 437–506, London
- FÜLÖP, J. (1971): Les formations jurassiques de la Hongrie. *Annales Inst. Geol. Publ. Hung.* 54/2, 31–46, Budapest
- FÜLÖP, J. (1976): The Mesozoic basement horst blocks of Tata. — *Geologica Hungarica series Geologica* 16, 229 p., Budapest
- FÜLÖP, J., KNAUER, J., VIGH, G. (1965): Ein Juraprofil im Vértesgebirge. — *Földtani Közlemény* 95/1, 54–61, Budapest (Hungarian with German abstract)
- GALÁCS, A. (1984): Jurassic of Hungary: A review. — *Acta Geologica Hungarica* 27/3–4, 359–377, Budapest
- GALÁCS, A., HORVÁTH, F., VÖRÖS, A. (1985): Sedimentary and structural evolution of the Bakony Mountains (Transdanubian Central Range, Hungary): Palaeogeographic implications. — *Acta Geologica Hungarica* 28/1–2, 85–100, Budapest
- GALÁCS, A., VÖRÖS, A. (1972): Jurassic history of the Bakony Mountains and interpretation of principal lithological phenomena. — *Földtani Közlemény* 102/2, 122–135 (Hungarian with English abstract)
- GÉCZY, B. (1961): Die jurassische Schichtreihe des Tüzköves-Grabens von Bakonycsérnye. — *Annales Inst. Geol. Publ. Hung.* 49/2, 393–443, Budapest
- GÉCZY, B. (1971a): The Pliensbachian of Kerics Hill, Bakony Mountains, Hungary. — *Annales Univ. Sci. Budapest., Sect. Geol.* 14, 29–52, Budapest
- GÉCZY, B. (1971b): The Pliensbachian of the Bakony Mountains. — *Acta Geologica Acad. Sci. Hung.* 15/1–4, 117–125, Budapest
- GÉCZY, B. (1972a): The Sinemurian in the Bakony Mountains. — *Acta Geologica Acad. Sci. Hung.* 16, 251–265, Budapest
- GÉCZY, B. (1972b): Ammonite faunas from the Lower Jurassic standard profile at Lókút, Bakony Mountains, Hungary. — *Annales Univ. Sci. Budapest., Sectio Geologica* 15, 47–77, Budapest
- GÉCZY, B. (1974): The Lower Jurassic ammonite faunas of the Southern Bakony (Transdanubia, Hungary). — *Annales Univ. Sci. Budapest., Sectio Geologica* 17 (1973), 181–190, Budapest
- GÉCZY, B. (1976): Les ammonitines du Carixien de la Montagne du Bakony. — *Akadémiai Kiadó, Budapest*, 223 p.

Fig. 6. Schematic palaeogeographic profile of Bakony unit in Hettangian time. Apparent differences in depositional environment are emphasized. Names of the zones are those of their Southern Alpine counterparts (KÁZMÉR and KOVÁCS, 1985). The Belluno trough displays condensed sedimentation, mostly with hiatuses in the Hettangian. The Trento plateau is a thick, shallow marine carbonate platform. In the Lombardian basin — due to the lack of more accurate data — the oldest Liassic (not necessarily Hettangian) sequences are figured. Also these ones indicate the dissected, predominantly deep marine character of the basin. Legend: see Fig. 4. Scale on the left indicates presumed water depth: 0–10 m: littoral; 10–30 m: above wave base; 30–100 m: euphotic; 100–300 m: shelf; below 300 m: slope or talus (after J. DERCOURT and H. FUNK, 1986, pers. comm.). Vertical dimensions are not to scale. Localities of Liassic profiles are projected on a 235°–55° line representing the long axis of the Bakony unit.

- HAAS, J. (1982): Facies analysis of the cyclic Dachstein limestone Formation (Upper Triassic) in the Bakony Mountains, Hungary. — *Facies* 6, 75–84, Erlangen
- HAAS, J., DOBOSI, K. (1982): Investigation of Upper Triassic cyclic carbonate rocks in key sections in the Bakony. — Annual Report of the Hungarian Geological Institute for 1980, 135–168, Budapest
- HAAS, J., JOCHA-EDELENYI, E., GIDAI, L., KAISER, M., KRETZOI, M., ORAVECZ, J. (1984): Sümeg és környékének földtani felépítése. (Geology of Sümeg and its surroundings.) — *Geologica Hungarica series Geologica* 20, 353 p., Budapest
- KÁZMÉR, M. (1986): Tectonic units of Hungary: Their boundaries and stratigraphy (A bibliographic guide). — *Annales Univ. Sci. Budapest., Sectio Geologica* 26, 45–120, Budapest
- KÁZMÉR, M., KOVÁCS, S. (1985): Permian-Paleogene paleogeography along the eastern part of the Periadriatic lineament: Evidence for continental escape of the Bakony-Drauzug unit. — *Acta Geologica Hungarica* 28/1–2, 69–82, Budapest
- KONDA, J. (1970): Lithologische und Fazies-Untersuchung der Jura-Ablagerungen des Bakony-Gebirges. — *Annales Inst. Geol. Publ. Hung.* 50/2, 161–260, Budapest
- KÖRÖSSY, L. (1965): Stratigraphischer und tektonischer Bau der westungarischen Becken. — *Földtani Közöny* 95/1, 22–36, Budapest (Hungarian with German abstract)
- MAJZON, L. (1966): Foraminiferavizsgálatok. (Foraminifer Investigations.) — *Akadémiai Kiadó*, Budapest, 939 p. (Hungarian)
- SZABÓ, I. (1961): A tatai mezozoos rög jura kifejlődései. (Jurassic facies of the Mesozoic horst at Tata.) — *Annales Inst. Geol. Publ. Hung.* 49/2, 469–474, Budapest (Hungarian)
- TELEGDI-ROTH, K. (1934): Daten aus dem nördlichen Bakony-Gebirge zur jungmesozoischen Entwicklungsgeschichte der „Ungarischen Zwischenmasse“. — *Mathematischer und Naturwissenschaftlicher Anzeiger der Ungarischen Akademie der Wissenschaften* 52, 205–252, Budapest
- URLICH, M. (1977): The Lower Jurassic in Southwestern Germany. — *Stuttgarter Beiträge zur Naturkunde B* 24, 41 p., Stuttgart
- VADÁSZ, M. E. (1911): Die Juraschichten der südlichen Bakony. — *Resultate der wissenschaftlichen Erforschung des Balatonsees*, I. Band, II. Teil, Anhang: Paläontologie der Umgebung des Balatonsees, III. Band, Teil IX, 89. p., Hölzel, Wien.
- VÉGH-NEUBRANDT, E. (1982): Triassische Megalodontaceae. Entwicklung, Stratigraphie und Paläontologie. — *Akadémiai Kiadó*, Budapest, 526 p.
- VIGH, GY. (1912): Liasschichten am dorogor Nagykőszikla. — *Földtani Közöny* 43, 502–506, Budapest
- WINTERER, E. L., BOSELLINI, A. (1981): Subsidence and sedimentation on Jurassic passive continental margin, Southern Alps, Italy. — *American Association of Petroleum Geologists Bulletin* 65/3, 394–421.